(Supplement to Instruction Manual)

High Performance, Multifunction Inverter

FRENIC-MEGA

About this document

This manual, a supplement for the FRENIC-MEGA series of inverters having a ROM version 3600 or later, contains addition, modification, and correction to the FRENIC-MEGA Instruction Manuals (INR-SI47-1183b-E, INR-SI47-1223c-E, INR-SI47-1334-E, and INR-SI47-1335a-E). For other descriptions, refer to the original manuals.

Checking the inverter's ROM version

The inverter's ROM version can be checked on Menu #5 "Maintenance Information" (5_ 14) as a 4-digit code. For the detailed keypad operation, refer to the inverter original manuals.

About newly added functions

The functions listed below are newly added to the FRENIC-MEGA series of inverters having a ROM version 3600 or later. For details about those functions, refer to Section 2 "Details of Function Codes Added" or the PG Interface Card Instruction Manual.

Inverter's ROM Version	Newly Added Functions
3600 or later	(1) Online tuning Performs tuning while the motor is rotating in order to cover the motor speed fluctuation caused by the temperature rise of the motor. (2) Function extension of brake signal Extends the brake-ON sequence function. (3) PG error processing Changes the PG error detection width if the speed command exceeds the base frequency. (4) Synchronous operation Enables synchronous operation of two motors equipped with a pulse generator (PG). The PG interface card (OPC-G1-PG or OPC-G1-PG22) is required. For details, refer to the PG Interface Card Instruction Manual. (5) Motor magnetic flux weakening control under "vector control without speed sensor" Improves the torque control stability. The overspeed detection level can be specified. (6) Improved regenerative power control under vector control Adjusts the motor magnetic flux level to be applied during deceleration under vector control. (7) Terminal command "Enable battery operation" ***BATRY*** (Function code data = 59) Cancels the undervoltage protection so that the inverter under an undervoltage condition runs the motor with battery power. (8) "0 to 20 mA" range added to analog input/output (9) Speed limit level adjustable with analog inputs under torque control

Note The PG interface card OPC-G1-PG22 is applicable to inverters having a ROM version 3510 or later.

Icons

The following icons are used throughout this manual.

Note This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

This icon indicates a reference to more detailed information.

1 Function Code Tables

Listed below are function codes added or modified in the FRENIC-MEGA series of inverters having a ROM version 3600 or later.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
F29 *1	Analog Output [FMA]/[FM1] (Mode selection)	0: Output in voltage (0 to 10 VDC) 1: Output in current (4 to 20 mA DC) 2: Output in current (0 to 20 mA DC)	Y	Y	0	Y	Y	Y	Y	Y	5
F31 *1	Analog Output [FMA]/[FM1] (Function)	17: Positional deviation in synchronous operation	Y	Y	0	N	Y	N	Y	N	5
F32	Analog Output [FM2] (Mode selection)	0: Output in voltage (0 to 10 VDC) 1: Output in current (4 to 20 mA DC) 2: Output in current (0 to 20 mA DC)	Y	Y	0	Y	Y	Y	Y	Y	5
F35 *1	Pulse Output [FMP] Analog Output [FM2] (Function)		Y	Y	0	N	Y	N	Y	N	5
E01	Terminal [X1] Function	59 (1059): Enable battery operation (***BATRY***)	N	Y	0	Y	Y	Y	Y	Y	5
E02	Terminal [X2] Function		N	Y	1						5
E03	Terminal [X3] Function		N	Y	2						5
E04	Terminal [X4] Function		N	Y	3						5
E05	Terminal [X5] Function		N	Y	4						5
E06	Terminal [X6] Function		N	Y	5						5
E07	Terminal [X7] Function		N	Y	*3						5
E08 *2	Terminal [X8] Function		N	Y	7						
E09 *2	Terminal [X9] Function		N	Y	8						
E20	Terminal [Y1] Function	29 (1029): Synchronization completed (***SY***)	N	Y	0	N	Y	N	Y	N	8
E21	Terminal [Y2] Function		N	Y	1						8
E22	Terminal [Y3] Function		N	Y	2						8
E23	Terminal [Y4] Function		N	Y	7						8
E24	Terminal [Y5A/C] Function		N	Y	15						8
E27	Terminal [30A/B/C] Function		N	Y	99						8
E61	Terminal [12] Extended Function	17: Speed limit FWD 18: Speed limit REV	N	Y	0	Y	Y	Y	Y	Y	8
E62	Terminal [C1] Extended Function		N	Y	0	Y	Y	Y	Y	Y	8
E63	Terminal [V2] Extended Function		N	Y	0	Y	Y	Y	Y	Y	8
E98	Terminal [FWD] Function	59 (1059): Enable battery operation (***BATRY***)	N	Y	98	Y	Y	Y	Y	Y	5
E99	Terminal [REV] Function		N	Y	99	Y	Y	Y	Y	Y	5
C40	Terminal [C1] Range Selection	0: 4 to 20 mA 1: 0 to 20 mA	N	Y	0	Y	Y	Y	Y	Y	8
P05	Motor 1 (Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	8
H81	Light Alarm Selection 1	0000 to FFFF (hex.)	Y	Y	0	Y	Y	Y	Y	Y	9
H82	Light Alarm Selection 2	0000 to FFFF (hex.)	Y	Y	0	Y	Y	Y	Y	Y	9
A19	Motor 2 (Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	8
b19	Motor 3 (Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	8
r19	Motor 4 (Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	8
A46	Speed Control 2 I (Integral time)	999: Disable integral action	Y	Y	0.100	N	Y	Y	Y	N	9
b46	Speed Control 3 I (Integral time)	999: Disable integral action	Y	Y	0.100	N	Y	Y	Y	N	9
r46	Speed Control 4 I (Integral time)	999: Disable integral action	Y	Y	0.100	N	Y	Y	Y	N	9
J96	Brake Signal (Speed condition selection)	0 to 31	N	Y	0						9
		Bit 0: Criterion speed for brake-ON (0: Detected speed, 1: Reference speed)				N	N	Y	Y	N	
		Bit 1: Reserved.				N	N	N	N	N	
		Bit 2: Response for brake-OFF current (0: Slow response, 1: Quick response)				Y	Y	Y	Y	N	
		Bit 3: Criterion frequency for brake-ON (0: Stop frequency (F25), 1: Brake-ON frequency (J71))				N	N	Y	Y	N	
		Bit 4: Output condition of brake signal (0: Independent of a run command ON/OFF 1: Only when a run command is OFF)				N	N	Y	Y	N	
d04	Speed Control 1 I (Integral time)	999: Disable integral action	Y	Y	0.100	N	Y	Y	Y	N	9

*1 [FM1] and [FM2] for Asia (FRN_ _ _G1■-□A) and EU (FRN_ _ _G1■-□E) versions

*2 Terminals [X8] and [X9] not provided on Asia (FRN_ _ _G1■-□A) or EU (FRN_ _ _G1■-□E) version

*3 "8" for Asia (FRN_ _ _G1■-□A) and EU (FRN_ _ _G1■-□E) versions; "6" for other versions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
d12	Speed Control (Jogging) I (Integral time)	999: Disable integral action	Y	Y	0.100	N	Y	Y	Y	N	9
d23	PG Error Processing	0: Continue to run 1 1: Stop running with alarm 1 2: Stop running with alarm 2 3: Continue to run 2 4: Stop running with alarm 3 5: Stop running with alarm 4	N	Y	2	N	Y	Y	Y	N	11
d35	Overspeed Detection Level	0 to 120% 999: Depends on setting of d32 or d33	Y	Y	999	N	Y	Y	Y	Y	12
d41	Application-defined Control	0: Disable (Ordinary control)	N	Y	0	Y	Y	Y	Y	Y	13
		1: Enable (Constant peripheral speed control)				N	Y	N	N	N	
		2: Enable (Simultaneous synchronization, without Z phase)				N	Y	N	Y	N	
		3: Enable (Standby synchronization)				N	Y	N	Y	N	
		4: Enable (Simultaneous synchronization, with Z phase)				N	Y	N	Y	N	
d60	Command (Encoder pulse resolution)	0014 to 0E10 (hex.) (20 to 3600 pulses)	N	Y	0400 (1024)	N	Y	N	Y	N	13
d71	Synchronous Operation (Main speed regulator gain)	0.00 to 1.50 times	Y	Y	1.00	N	Y	N	Y	N	13
d72	(APR P gain)	0.00 to 200.00 times	Y	Y	15.00	N	Y	N	Y	N	13
d73	(APR positive output limiter)	20 to 200%, 999: No limiter	Y	Y	999	N	Y	N	Y	N	13
d74	(APR negative output limiter)	20 to 200%, 999: No limiter	Y	Y	999	N	Y	N	Y	N	13
d75	(Z phase alignment gain)	0.00 to 10.00 times	Y	Y	1.00	N	Y	N	Y	N	13
d76	(Synchronous offset angle)	0 to 359 degrees	Y	Y	0	N	Y	N	Y	N	13
d77	(Synchronization completion detection angle)	0 to 100 degrees	Y	Y	15	N	Y	N	Y	N	13
d78	(Excessive deviation detection range)	0 to 65535 (Display in units of 10 pulses) (For 10000 or more: Display of the upper four digits in units of 100 pulses)	Y	Y	65535 *4	N	Y	N	Y	N	13
d81	Reserved	0 or 1	Y	Y	1	-	-	-	-	-	-
d82	Magnetic Flux Weakening Control (Vector control without speed sensor)	0: Disable 1: Enable	Y	Y	1	N	N	N	N	Y	13
d83	Magnetic Flux Weakening Low Limiter (Vector control without speed sensor)	10 to 70%	Y	Y	40%	N	N	N	N	Y	13
d84	Reserved	0 to 20 dB	Y	Y	5 dB	-	-	-	-	-	-
d85	Reserved	0 to 200%	Y	Y	95%	-	-	-	-	-	-
d90	Magnetic Flux Level during Deceleration (Vector control)	100 to 300%	Y	Y	150%	N	N	Y	Y	N	14
d91	Reserved	0.00 to 2.00, 999	Y	Y	999	-	-	-	-	-	-
d92	Reserved	0.00 to 3.00	Y	Y	0.00	-	-	-	-	-	-
d98	Reserved	0000 to FFFF (hex.)	Y	Y	0000	Y	Y	N	N	N	-
d99	Function Extension 1	0 to 31	Y	Y	0						14
		Bit 0: Reserved				-	-	-	-	-	
		Bit 1: Reserved				-	-	-	-	-	
		Bit 2: Reserved				-	-	-	-	-	
		Bit 3: ***JOG*** (Ready for jogging) via the communications link (0: Disable, 1: Enable)				Y	Y	Y	Y	N	
		Bit 4: Reserved				-	-	-	-	-	
U01	Customizable Logic: (Input 1)	29 (1029): Synchronization completed (***SY***)	N	Y	0	N	Y	N	Y	N	8
U02	Step 1 (Input 2)		N	Y	0						8
U06	Customizable Logic: (Input 1)		N	Y	0						8
U07	Step 2 (Input 2)		N	Y	0						8
U11	Customizable Logic: (Input 1)		N	Y	0						8
U12	Step 3 (Input 2)		N	Y	0						8
U16	Customizable Logic: (Input 1)		N	Y	0						8
U17	Step 4 (Input 2)		N	Y	0						8
U21	Customizable Logic: (Input 1)		N	Y	0						8
U22	Step 5 (Input 2)		N	Y	0						8
U26	Customizable Logic: (Input 1)		N	Y	0						8
U27	Step 6 (Input 2)		N	Y	0						8
U31	Customizable Logic: (Input 1)		N	Y	0						8
U32	Step 7 (Input 2)		N	Y	0						8

*4 The standard keypad displays 6553 on the LED monitor and lights the x10 LED.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
U36	Customizable Logic: (Input 1)		N	Y	0						8
U37	Step 8 (Input 2)		N	Y	0						8
U41	Customizable Logic: (Input 1)		N	Y	0						8
U42	Step 9 (Input 2)		N	Y	0						8
U46	Customizable Logic: (Input 1)		N	Y	0						8
U47	Step 10 (Input 2)		N	Y	0						8
U81	Customizable Logic Output Signal 1 (Function selection)	59 (1059): Enable battery operation (***BATRY***)	N	Y	100	Y	Y	Y	Y	Y	5
U82	Customizable Logic Output Signal 2		N	Y	100	Y	Y	Y	Y	Y	5
U83	Customizable Logic Output Signal 3		N	Y	100	Y	Y	Y	Y	Y	5
U84	Customizable Logic Output Signal 4		N	Y	100	Y	Y	Y	Y	Y	5
U85	Customizable Logic Output Signal 5		N	Y	100	Y	Y	Y	Y	Y	5

2 Details of Function Codes Added

F29 **Analog output [FMA]/[FM1] (Mode selection) ***

F32 **Analog output [FM2] (Mode selection) ***

* [FM1] and [FM2] are for Asia (FRN_ _ _G1■-□A) and EU (FRN_ _ _G1■-□E) versions.

Versions except Asia (FRN_ _ _G1■-□A) and EU (FRN_ _ _G1■-□E) versions

■ Mode selection (F29)

F29 specifies the property of the output to terminal [FMA]. You need to set switch SW4 on the control printed circuit board (control PCB).

Data for F29	[FMA] output form	Position of slide switch SW4 mounted on the control PCB
2	Current (0 to +20 mA DC)	IO

Asia (FRN_ _ _G1■-□A) and EU (FRN_ _ _G1■-□E) versions

■ Mode selection (F29 and F32)

F29 and F32 specify the property of the output to terminals [FM1] and [FM2], respectively. You need to set the slide switches on the control printed circuit board (control PCB).

Output form	Terminal [FM1]		Terminal [FM2]	
	Data for F29	Position of slide switch SW4 on the control PCB	Data for F32	Position of slide switch SW6 on the control PCB
Current (0 to +20 mA DC)	2	IO1	2	IO2

F31 **Analog Output [FMA]/[FM1] (Function) ***

F35 **Pulse Output [FMP] (Function)**
Analog Output [FM2] (Function) *

* [FM1] and [FM2] are for Asia (FRN_ _ _G1■-□A) and EU (FRN_ _ _G1■-□E) versions.

These function codes enable monitoring of deviation in angle in synchronous operation. For details about synchronous operation, refer to the PG Interface Card Instruction Manual.

Data for F31 / Data for F35	[FMA]/[FM1] output / [FMP]/[FM2] output	Function (Monitor the following)	Meter scale (Full scale at 100%)
17	Positional deviation in synchronous operation	Deviation in angle	0% to 50% to 100%, representing -180° to 0° to +180° of the deviation

E01 to E09 **Terminal [X1] to [X9] Function**
E01 to E07 **Terminal [X1] to [X7] Function ***

E98 **Terminal [FWD] Function**
E99 **Terminal [REV] Function**

U81 to U85 **Customizable Logic Output Signal 1 to 5 (Function selection)**

* Terminals [X8] and [X9] are not provided on Asia (FRN_ _ _G1■-□A) or EU (FRN_ _ _G1■-□E) version.

Function code data		Terminal commands assigned	Symbol	Drive control					Related function codes
Active ON	Active OFF			V/f	PG V/f	w/o PG	w/ PG	Torque control	
59	1059	Enable battery operation	***BATRY***	Y	Y	Y	Y	Y	

■ Enable battery operation -- ***BATRY*** (Function code data = 59)

Turning this terminal command ON cancels the undervoltage protection so that the inverter runs the motor with battery power under an undervoltage condition.

When ***BATRY*** is assigned to any digital input terminal, the inverter trips after recovery from power failure just as F14 = 1 regardless of F14 setting. When ***BATRY*** is ON, the main power down detection is disabled regardless of H72 setting.

Note **Prerequisites for battery operation**

(1) The terminal command ***BATRY*** (data = 59) must be assigned to any digital input terminal.

(2) A DC link bus voltage must be supplied from the battery to the main circuit (L1/R-L3/T or L2/S-L3/T) as shown in Figures A and B given below.

(3) A regulated voltage (sine-wave or DC voltage) must be supplied to the auxiliary power supply (R0-T0).

(4) For 200 V class series of 37 kW or above and 400 V ones of 75 kW or above, a regulated voltage (sine-wave) must be supplied to the auxiliary fan power supply (R1-T1) as shown in Figure B. The fan power supply connector must be configured for battery operation as shown in Figure C.

(5) The ***BATRY***-assigned terminal (data = 59) must be turned ON at the same moment as closing of MC2.

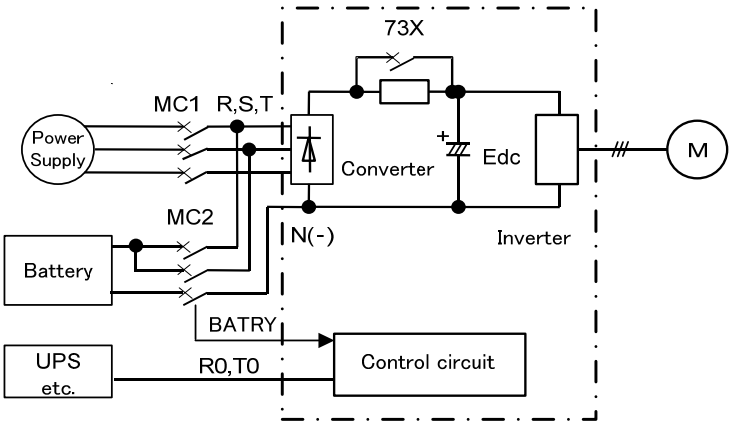


Figure A Connection Diagram
for 200 V Class Series of 30 kW or Below and 400 V Ones of 55 kW or Below

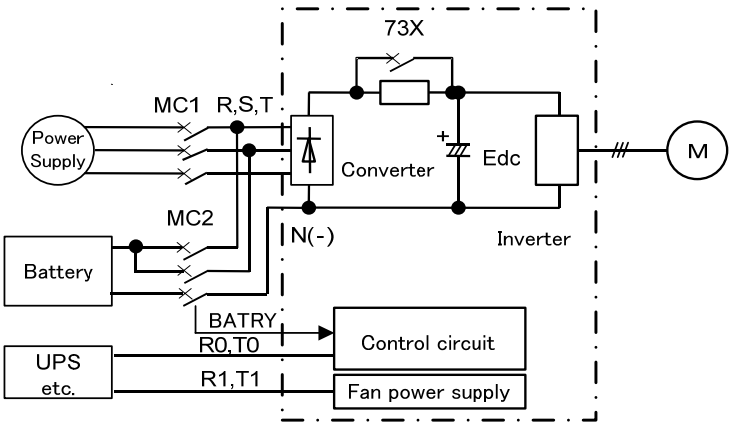


Figure B Connection Diagram
for 200 V Class Series of 37 kW or Above and 400 V Ones of 75 kW or Above

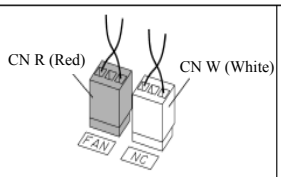
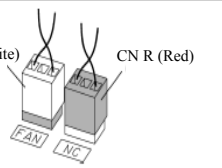
Setting		
Usage	When not using R1 or T1 (Factory default)	When using R1 and T1 (BATRY operation)

Figure C Fan Power Supply Switching Connector

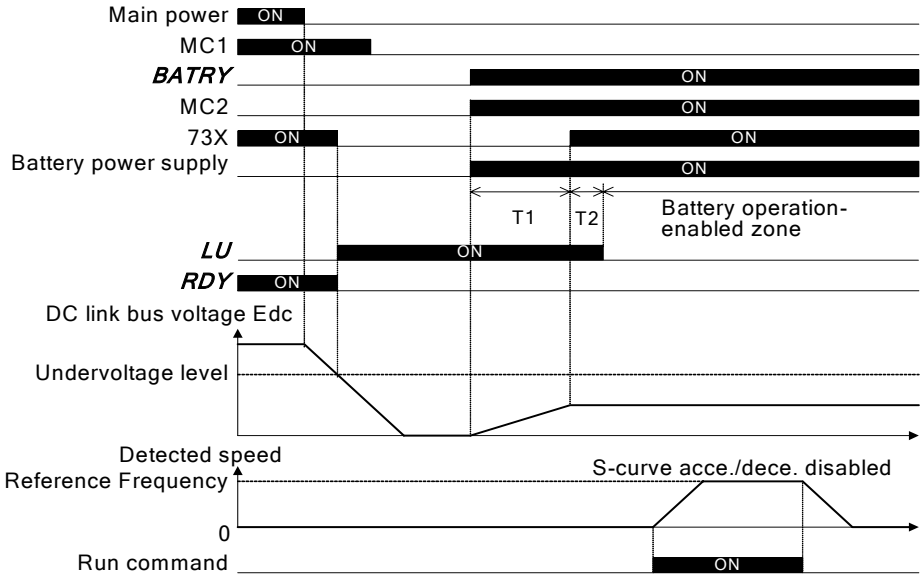
Note **About battery operation (when *BATRY* is ON)**

(1) The undervoltage protective function (*LU*) is deactivated.

(2) The inverter can run the motor even under an undervoltage condition.

(3) The ***RDY*** ("Inverter ready to run") output signal is forcedly turned OFF.

(4) The bypass circuit of the charging resistor comes to be closed (73X ON) after a delay of time T1 from when the ***BATRY*** is turned ON. Further, after a delay of time T2 (a maximum of 0.1 second), the battery operation starts. For the specifications of T1, see the table below.



Battery Operation Timing Diagram

T1 from ***BATRY*** ON to 73X ON

Power condition	30 kW or below	37 kW or above
After the control power supply goes OFF, the battery power and control power are turned ON.	100 ms	500 ms
The control power remains ON or after a momentary power failure happens.	205 ms	

(5) The S-curve acceleration/deceleration is disabled.

(6) The battery operation speed can be calculated by the following formula.

$$\text{Reference speed (pre-ramp) during battery operation} \leq \frac{\text{Battery voltage} - 5[V]}{\sqrt{2} \times \text{Rated voltage}} \times \text{Rated speed} \times \text{k}$$

Where,

Battery voltage: 24 VDC or higher for 200 V class series
48 VDC or higher for 400 V class series.
Rated speed : F04
Rated voltage : F05 (Motor rated voltage (V))
k: Safety coefficient (Less than 1, about 0.8)

Precautions

(1) The battery power supply must be connected before or at the same moment as turning ON of ***BATRY***.

(2) As shown in the timing diagram above, battery operation is possible within the battery operation-enabled zone. There is a delay of "T1 + T2" after the ***BATRY***, MC2, and battery power supply are turned ON.

(3) The ***BATRY*** must not be turned ON when the voltage level is higher than the specified undervoltage level (that is, before the *LU* appears after a power failure). Turning the ***BATRY*** ON causes the bypass circuit (73X) of the charging resistor to stick to ON (closed).

(4) During battery operation, driving with a heavy load must be avoided and the motor must run with no load or braking load condition. Low battery voltage cannot generate sufficient torque, causing the motor to stall.

(5) The battery operation must be performed at a low speed. Be careful with the battery capacity.

When a high voltage (e.g., 300 VDC for 200 V class series of inverters or 600 VDC for 400 V ones) is applied, not battery operation but normal operation must be performed.

(6) In normal operation, the ***BATRY*** must be OFF. Turning the main power supply ON with the ***BATRY*** being ON could damage the rectifier diode because the 73X is ON.

E20 to E23 **Terminal [Y1] to [Y4] Function**
E24, E27 **Terminal [Y5A/C] and [30A/B/C] Functions (Relay output)**

U01, U02 … U46, U47 **Customizable Logic: Step 1 to 10 (Input 1, Input 2)**

Function code data		Functions assigned	Symbol	Drive control				
Active ON	Active OFF			V/f	PG V/f	w/o PG	w/ PG	Torque control
29	1029	Synchronization completed	***SY***	N	Y	N	Y	N

■ Synchronization completed -- ***SY*** (Function code data = 29)

This output signal comes ON when the control target comes inside the synchronization completion detection angle in synchronous operation.

For details about synchronous operation, refer to the PG Interface Card Instruction Manual.

E61 **Terminal [12] Extended Function**
E62 **Terminal [C1] Extended Function**
E63 **Terminal [V2] Extended Function**

E61, E62, and E63 define the function of the terminals [12], [C1], and [V2], respectively.

As listed below, under torque control, analog inputs through terminals [12], [C1], and [V2] specify the motor speed limit values. To limit the motor speed to the maximum frequency (F02, A01, b01, r01), apply a full-scale analog input (maximum input).

It is recommended that this speed limit function be used together with d35 (Overspeed detection level).

Data for E61, E62, or E63	Input assigned to [12], [C1] and [V2]
17	Speed limit FWD
18	Speed limit REV

Note Function codes C31 to C45 (Analog input adjustment) apply to these analog inputs.

C40 **Terminal [C1] Range Selection**

C40 specifies the range of the input current signal on terminal [C1] as listed below.

Data for C40	Range of Input Current Signal on Terminal [C1]
0	4 to 20 mA
1	0 to 20 mA

P05, A19 b19, r19 **Motor 1/2/3/4 (Online tuning)**

Long run under "Dynamic torque vector control" or "Slip compensation control" causes motor temperature change, varying the motor parameters. This changes the motor speed compensation amount, resulting in motor speed deviation from the initial rotating speed.

Enabling online tuning identifies motor parameters covering the motor temperature change to decrease the motor speed fluctuation.

To perform online tuning enabled with P05/A19/b19/r19, set P04 (Auto-tuning) to "2."

Note Note: Online tuning can be performed only when F42 = 1 (Dynamic torque vector control) or when F42 = 2 (V/f control with slip compensation active) and F37 = 2 or 5 (Auto torque boost).

A46, b46, r46, d04, d12 Speed Control 2, Speed Control 3, Speed Control 4, Speed Control 1, Speed Control (Jogging) (Integral time)

These function codes are used to configure the Automatic Speed Regulator (ASR) by selecting the PI controller or P controller.

Setting the function code data to "999" selects the P controller.

H81, H82 Light Alarm Selection 1 and 2

Assigning "1" to bit 2 of H82 defines excessive positioning deviation in synchronous operation as a light alarm.

For details about excessive positioning deviation, refer to the PG Interface Card Instruction Manual.

For details about definition of light alarms, refer to the FRENIC-MEGA Instruction Manual, Chapter 5.

Light Alarm Selection 2 (H82), Bit Assignment of Selectable Factors

Bit	Code	Content
2	Er-□	Positioning control error

Note Even if a positioning control error is defined as a light alarm with H82, the error that occurred when the inverter was servo-locked does not cause a light alarm operation but trips the inverter.

J68 to J72 J95, J96 Brake Signal

These function codes are for the brake releasing/turning-on signals of vertical carrier machines.

It is possible to set the conditions of the brake releasing/turning-on signals (current, frequency or torque) so that a hoisted load does not fall down at the start or stop of the operation, or so that the load applied to the brake is reduced.

Releasing the Brake

When any of the inverter output current, output frequency, or torque command value exceeds the specified level of the brake signal (J68/J69/J95) for the period specified by J70 (Brake signal (Brake-OFF timer)), the inverter judges that required motor torque is generated and turns the signal ***BRKS*** ON for releasing the brake.

This prevents a hoisted load from falling down due to an insufficient torque when the brake is released.

Function code	Name	Data setting range	Remarks
J68	Brake-OFF current	0% to 300%:	
J69	Brake-OFF frequency/speed	0.0 to 25.0 Hz	Available only under V/f control.
J70	Brake-OFF timer	0.0 to 5.0 s	
J95	Brake-OFF torque	0% to 300%	Available only under vector control.
J96	Speed condition selection (Braking conditions)	Response for brake-OFF current (Bit 2) 0: Slow response (default) 1: Quick response	Specifies the response type for brake-OFF current detection. Selecting slow response inserts a detection filter into the current detection circuit so that the brake-OFF timing will be slightly behind the rising edge of the actual current. If the delay is not negligible with adjustments, select quick response.

Turning the Brake ON

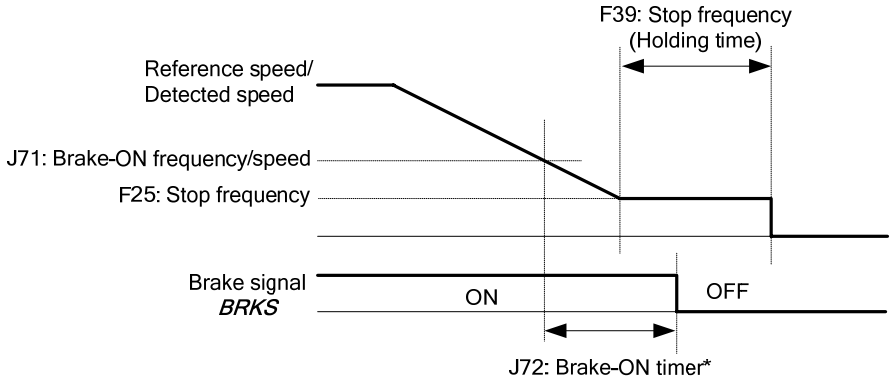
When the run command is OFF and the output frequency drops below the level specified by J71 (Brake signal (Brake-ON frequency/speed)) and stays below the level for the period specified by J72 (Brake signal (Brake-ON timer)), the inverter judges that the motor rotation is below a certain level and turns the signal ***BRKS*** OFF for activating the brake.

Under vector control, when the reference speed or the detected one drops below the level of the brake-ON frequency (specified by bit 3 of J96) and stays below the level for the period specified by J72 (Brake signal (Brake-ON timer)), the inverter judges that the motor rotation is below a certain level and turns the signal ***BRKS*** OFF for activating the brake.

This operation reduces the load applied to the brake, extending lifetime of the brake.

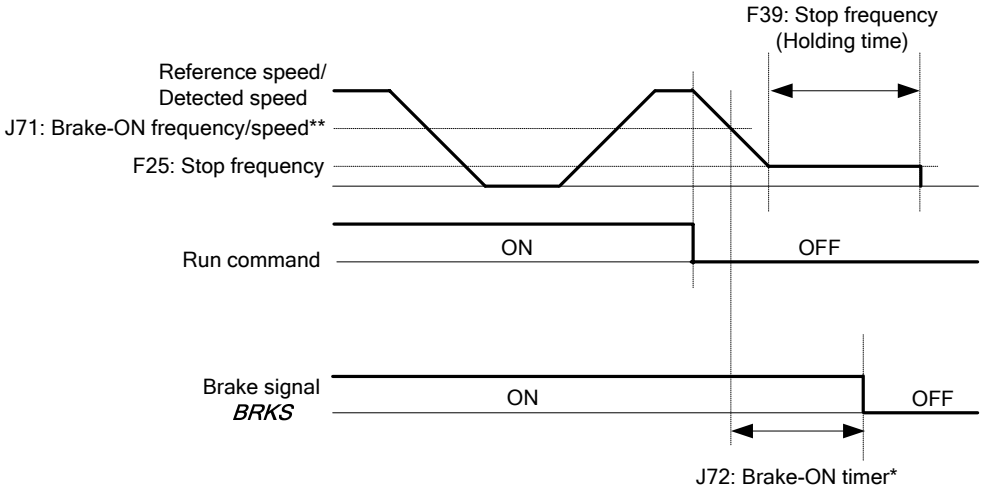
Function code	Name	Data setting range	Remarks
J71	Brake-ON frequency/speed	0.0 to 25.0 Hz	
J72	Brake-ON timer	0.0 to 5.0 s	
J96	Speed condition selection (Braking conditions)	Criteria of speed condition for brake-ON (Bit 0) 0: Detected speed 1: Reference speed	(Available only under vector control.) Specifies the criteria of speed to be used for brake-ON condition. When "Vector control without speed sensor" is selected, specify "Reference speed" (Bit 0 = 1).
		Criteria of frequency for brake-ON (Bit 3) 0: Stop frequency (F25) 1: Brake-ON frequency (J71)	(Available only under vector control.) Specifies the criteria of frequency to be used for brake-ON timing. If "Detected speed" and "Stop frequency" are selected (Bit 0 = 0 and Bit 3 = 0) to determine brake-ON timing, the brake may be applied after running at the stop frequency (F25) due to a speed error. If it is required that brake is applied during running at the stop frequency, select "Brake-ON frequency" (Bit 3 = 1) as criteria of frequency. When jogging or inching the motor for vertical conveyance, use J71 as brake-ON frequency.
		Turn-on condition of brake signal (Bit 4) 0: Independent of a run command ON/OFF 1: Only when a run command is OFF	(Available only under vector control.) Specifies whether to turn on a brake signal independent of a run command ON/OFF or only when a run command is OFF. When normal and reverse operations are switched, brake-ON conditions may be met in the vicinity of zero speed. For such a case, select "Only when a run command is OFF" (Bit 4 = 1).

• Operation time chart when Criteria of frequency for brake-ON (Bit 3) = 1 (Brake-ON frequency)



*If the inverter output is shut down during the timer period specified by J72, the inverter ignores the timer count and activates the brake.

• Operation time chart when Turn-on condition of brake signal (Bit 4) = 1 (Only when a run command is OFF)



*If the inverter output is shut down during the timer period specified by J72, the inverter ignores the timer count and activates the brake.

**When bit 3 of J96 = 1

d23 PG Error Processing

d23 defines the detection condition and error processing to be applied when a PG error occurs.

- Data setting range: d23 = 0, 1, 2, 3, 4, 5

Data for d23	Function
0	Continue to run 1
1	Stop running with alarm 1
2	Stop running with alarm 2
3	Continue to run 2
4	Stop running with alarm 3
5	Stop running with alarm 4

If the speed regulator's deviation (between the reference speed and detected one) is out of the specified range (d21) for the specified period (d22), the inverter judges it as a PG error.

d23 defines the detection condition (and exception), processing after error detection, and hysteresis width as listed below.

Data for d23	Detection condition (and exception)	Processing after error detection	Hysteresis width for error detection
0	When the inverter cannot follow the reference speed (even after soft-starting) due to a heavy overload or similar, so that the detected speed is less than the reference speed, the inverter does not interpret this situation as a PG error.	The inverter outputs the PG error detected signal ***PG-ERR*** and continues to run.	Detection width = d21 × Maximum frequency, which is constant even if the speed command is above the base frequency (F04).
1		The inverter initiates a motor coast to stop, with the Er-E alarm. It also outputs the PG error detected signal ***PG-ERR***.	
2	No exception.		
3	When the inverter cannot follow the reference speed (even after soft-starting) due to a heavy overload or similar, so that the detected speed is less than the reference speed, the inverter does not interpret this situation as a PG error.	The inverter outputs the PG error detected signal ***PG-ERR*** and continues to run.	If the speed command is below the base frequency (F04), detection width = d21 × Maximum frequency, which is constant. If it is above the base frequency, detection width = d21 × Speed command × Maximum frequency ÷ Base frequency (F04).
4		The inverter initiates a motor coast to stop, with the Er-E alarm. It also outputs the PG error detected signal ***PG-ERR***.	
5	No exception.		

d35 specifies the overspeed detection level under torque control by percentage of the maximum frequency (F03, A01, b01, r01).

If the following condition is satisfied, the inverter detects an overspeed state and issues an overspeed alarm 05.

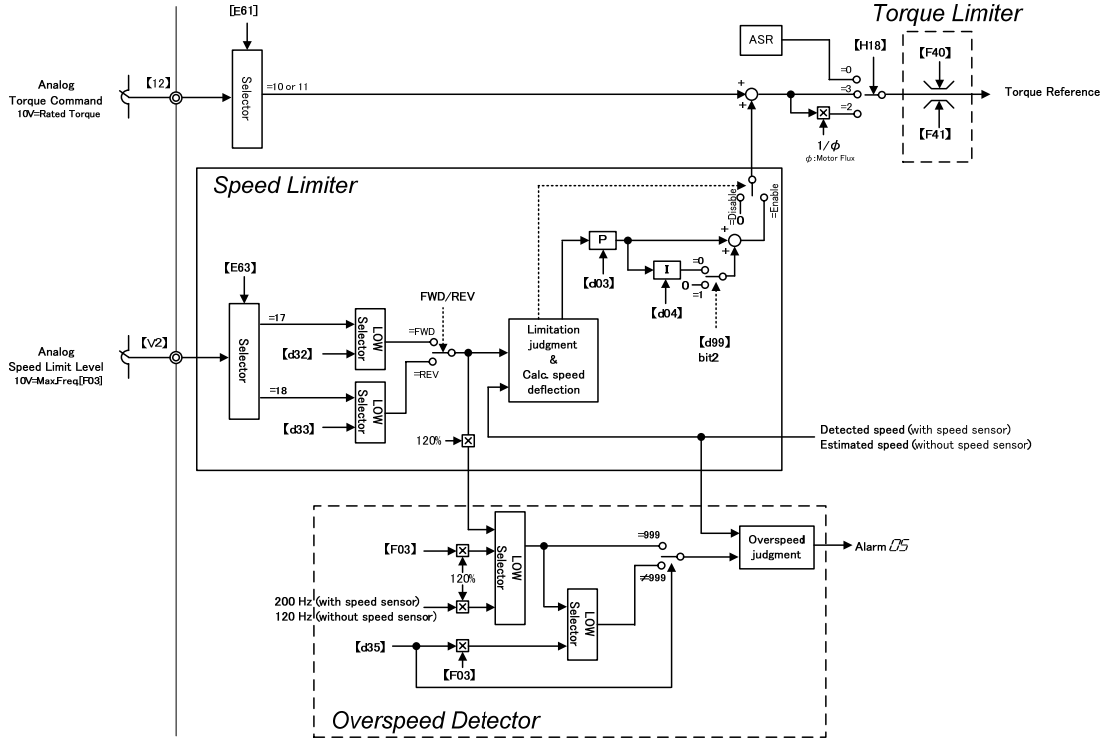
Motor speed ≥ Maximum frequency (F03/A01/b01/r01) × d35

Setting d35 data to "999" causes the inverter to issue an overspeed alarm 05 if either of the following conventional conditions is satisfied.

Motor speed ≥ Maximum frequency (F03/A01/b01/r01) × (d32 or d33) × 1.2

or

Motor speed ≥ 200 Hz (vector control with speed sensor) or 120 Hz (vector control without speed sensor) × (d32 or d33) × 1.2



Block Diagram of Torque Control

Note **Torque/Torque current command**

It is possible to command torque/torque current from an analog voltage input (terminal [12] or [V2]) or analog current input (terminal [C1]), or via the communications link (function codes S02 and S03).

(To use the analog voltage/current input, function codes E61 (terminal [12]), E62 (terminal [C1]), and E63 (terminal [V2]) should be set to 10 or 11 as shown in the table below.

Input	Command form	Function codes	Setting specifications (Factory default)
Terminal [12] (-10 V to 10 V)	Torque command	E61=10	Motor rated torque ±100% / ±10V
	Torque current command	E61=11	Motor rated torque current ±100% / ±10V
Terminal [V2] (-10 V to 10 V)	Torque command	E63=10	Motor rated torque ±100% / ±10V
	Torque current command	E63=11	Motor rated torque current ±100% / ±10V
Terminal [C1] (0, 4 to 20 mA)	Torque command	E62=10	Motor rated torque 100% / 20 mA
	Torque current command	E62=11	Motor rated torque current 100% / 20 mA
S02 (-327.68 to 327.67%)	Torque command	-	Motor rated torque / ±100.00%
S03 (-327.68 to 327.67%)	Torque current command	-	Motor rated torque current / ±100.00%

Function codes C31 to C45 (Analog input adjustment) are applied to these analog inputs.

Speed limiter

The response of the speed limiter can be adjusted by using P gain and Integral time of the speed control as listed below.

Selected Motor	Function Codes	
	P gain	Integral time
M1	d03	d04
M2	A45	A46
M3	b45	b46
M4	r45	r46

d41 Application-Defined Control

d41 selects/deselects constant peripheral speed control or synchronous operation (simultaneous or standby synchronization).

Constant peripheral speed control suppresses an increase in peripheral speed (line speed) resulting from the increasing radius of the take-up roll in a winder system.

Synchronous operation drives two or more shafts of a conveyer while keeping their positions in synchronization. For details about synchronous control, refer to the PG Interface Card Instruction Manual.

■ Application-Defined Control (d41)

Data for d41	Function
0	Disable (Ordinary control)
1	Enable (Constant peripheral speed control) 🕮 Refer to the FRENIC-MEGA User's Manual, Chapter 5, Section 5.4.8 "d codes (Application functions 2)."
2	Enable (Simultaneous synchronization, without Z phase)
3	Enable (Standby synchronization)
4	Enable (Simultaneous synchronization, with Z phase)

d60 to d63 Command (Pulse Rate Input) (Encoder pulse resolution, Filter time constant, Pulse count factor 1, Pulse count factor 2)

d71 to d78 Synchronous Operation

These function codes specify various parameters required for synchronous operation. For details, refer to the PG Interface Card Instruction Manual.

d82 Magnetic Flux Weakening Control (Vector control without speed sensor)

Setting d82 data to "1" (Enable) controls the motor magnetic flux in accordance with the torque command.

When the torque command value is small, this control weakens the motor magnetic flux to improve the control stability.

d83 Magnetic Flux Weakening Low Limiter (Vector control without speed sensor)

d83 applies to the lower limit of the motor magnetic flux level when d82 = 1 (Enable).

Decreasing the d83 setting too much may cause hunting, speed stagnation, and other problems.

Use the default setting "40%" as long as there is no problem.

d90 Magnetic Flux Level during Deceleration (Vector control)

d90 specifies the magnetic flux level to be applied during deceleration under vector control by percentage of the rated motor magnetic flux (determined by P06/A20/b20/r20).

d90 data takes effect only when H71 = 1 (Deceleration Characteristics enabled) and F42/A14/b14/r14 = 5 or 6 (Vector control with/without speed sensor).

Increasing the d90 setting can reduce the deceleration time but increases the inverter output current and the motor temperature rise. In applications repeating frequent start/stop drive, an overload may apply to the inverter or motor.

Adjust the d90 setting so that the inverter output current (RMS equivalent) comes to be smaller than the motor rated current.

Use the default setting "150%" as long as there is no problem.

d99 Function Extension 1

Setting bit 3 of d99 to "1" enables a ***JOG*** ("Ready for jogging") given via the communications link.

Note Other bits of d99 are reserved for particular manufacturer, so do not change the settings.

3 Monitoring the running status -- Menu #3 "Drive Monitoring" --

Listed below are monitoring items added or modified in the FRENIC-MEGA series of inverters having a ROM version 3000 or later.

LED monitor shows:	Item	Unit	Description
3_17	Target position pulse (synchronous operation)	Pulse	Shows the target position pulse for synchronous operation.
3_18	Current position pulse (synchronous operation)	Pulse	Shows the current position pulse for synchronous operation.
3_19	Current deviation pulse (synchronous operation)	Pulse	Shows the current deviation pulse for synchronous operation.
3_20	Control status monitor (synchronous operation)	--	Shows the current control status. 0: Synchronous operation disabled 20: Synchronous operation canceled 21: Synchronous operation stopped 22: Waiting for detection of Z phase 23: Z phase of reference PG detected 24: Z phase of slave PG detected 25: Synchronization in progress 26: Synchronization completed
3_26	Positioning deviation (synchronous operation)	degree	Shows the positioning deviation (in degree) for synchronous operation.

4 List of Errata

The table below provides a list of errata for the FRENIC-MEGA Instruction Manuals (INR-SI47-1183b-E, INR-SI47-1223c -E, INR-SI47-1334-E, and INR-SI47-1335a-E).

Page				Wrong	Correct (underlined)
1183b	1223c	1334	1335a		
vii	-	v	-	Fuse rating column (IEC number): (FRN3.7G1■-2□/FRN3.7G1■-4□ or lower models) IEC60269-1	IEC60269-2
				Current rating in the fuse rating column: (FRN55G1■-4□) 400 (IEC60269-4)	350 (IEC60269-4)
ix	-	vi	-	Standard in item 9: EN60204 Appendix C.	IEC60364-5-52
				Note to be added.	In a power supply system (I-T NET) where a neutral point is not grounded, the control terminals are provided with basic insulation from the mains. If a person may touch them directly, an external insulation circuit should be added for double insulation.
					Grounding terminal can accept one wire only.
3-15	-	3-12	-	I/O Check Item, 4_ 15, 4_ 17 Shows the pulse rate (p/s) of the A/B phase signal…	Shows the pulse rate of the A/B phase signal… (e.g., 1000 p/s is expressed as 1.00.)
5-7	-	5-7	-	Drive control of E31, E32 Torque control: N	Torque control: Y
5-10	-	5-9	-	C32, C37, C42 Data setting range: 0.00 to 200.00%	0.00 to 400.00%
-	-	5-10	-	P56 Default setting: 85%	85% (90% for inverters of 132 kW or above)
5-12	-	5-11	-	H13 Data setting range: 0.1 to 10.0 s	0.1 to 20.0 s
				Drive control of H15 w/o PG: Y w/ PG: Y	w/o PG: N w/ PG: N
5-12	-	5-11, 5-100	-	H46 Data setting range: 0.1 to 10.0 s	0.1 to 20.0 s
5-14	-	5-12, 5-109	-	H80 Data setting range: 0.00 to 0.40 Drive control: Torque Control :Y	0.00 to 1.00 Torque Control : N
5-14	-	5-12	-	Drive control of H92, H93 w/o PG: Y w/ PG: Y	w/o PG: N w/ PG: N
5-16, 5-18, 5-20	-	5-14, 5-16, 5-18	-	A56, b56, r56 Default setting: 85%	85% (90% for inverters of 132 kW or above)
5-22	-	5-19	-	d55 Data setting range: 0, 1 d55 Default setting: 0	0000 to 00FF (in hex.) 0000
5-22	5-22	5-19	5-19	d68 Default setting: 40	4.0

Page				Wrong	Correct (underlined)
1183b	1223c	1334	1335a		
5-85, 5-87	-	5-110, 5-111	-	H81, H82: Light Alarm Selection 1 and 2 "PID feedback wire break" to be added.	Addition of Light Alarm Factor Code: E□/F Name: PID feedback wire break Description: The PID feedback signal wire(s) is broken. Table 5.2 Light Alarm Selection 2 (H82), Bit Assignment of Selectable Factors Bit: 3 Code: E□/F Content: PID feedback wire break
5-92	-	5-117	-	Table 5.5 Function Codes to be Switched Last line Reserved: d57 A57, b57, r57	P57, A57, b57, r57
-	-	5-127	-	J62 PID Control (PID control block selection) Table When J62 = 0, 1: Absolute value (Hz) When J62 = 2,3: Ratio (%)	When J62 = 0, 1: Ratio (%) When J62 = 2,3: Absolute value (Hz)
-	-	8-2 to 8-4	-	Noncompliance note to be added to "Applicable safety standards C22.2 No. 14."	The following inverters are not compliant with C22.2 No. 14. FRN160G1■-4□ to FRN220G1■-4□ FRN355G1■-4□, FRN400G1■-4□

5 Note

Difference of notation between standard keypad and remote keypad

Descriptions in this manual are based on the standard keypad having a *four*-digit, 7-segment LED monitor (shown in the original FRENIC-MEGA Instruction Manuals, Chapter 3). The FRENIC-MEGA also provides a multi-function keypad as an option, which has an LCD monitor and a *five*-digit, 7-segment LED, but has no USB port.

If the standard keypad is replaced with an optional multi-function keypad, the display notation differs as shown below.

Function code	Name	Standard keypad	Multi-function keypad (TP-G1-J1)
H42	Capacitance of DC Link Bus Capacitor	Hexadecimal notation	Decimal notation
H44	Startup Counter for Motor 1		
H47	Initial Capacitance of DC Link Bus Capacitor		
H79	Preset Startup Count for Maintenance (M1)		
A52	Startup Counter for Motor 2		
b52	Startup Counter for Motor 3		
r52	Startup Counter for Motor 4		
d15	Feedback Input (Encoder pulse resolution)		
d60	Command (Pulse Rate Input) (Encoder pulse resolution)		
H43	Cumulative Run Time of Cooling Fan	Display in units of 10 hours	Display by hours
H48	Cumulative Run Time of Capacitors on Printed Circuit Boards		
H77	Service Life of DC Link Bus Capacitor (Remaining time)		
H78	Maintenance Interval (M1)		
H94	Cumulative Motor Run Time 1		
A51	Cumulative Motor Run Time 2		
b51	Cumulative Motor Run Time 3		
r51	Cumulative Motor Run Time 4		
d78	Synchronous Operation (Excessive deviation detection range)	Display in units of 10 pulses. (For 10000 pulses or more: Display in units of 100 pulses, with the x10 LED ON)	Display in units of 10 pulses

High Performance, Multifunction Inverter

FRENIC-MEGA

Supplement to Instruction Manual

First Edition, November 2010

Fuji Electric Systems Co., Ltd.

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the FRENIC-MEGA series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric Systems Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.